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A WORLD SOIL FILE FOR GLOBAL CLIMATE MODELING

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Abstract

This report describes the structure and limitations of a world soil data file of 15,413 records designed for use with a global atmosphere circulation model. Soil data were obtained from the Soil Map of the World, Food and Agricultural Organization, FAO, scale 1:5,000,000. Each record is for a 1° lat. x 1° long. cell; the file describes dominant, associated, and included soil units (defined according to the FAO classification), as well as surface texture, slope, and auxiliary information. The soil file corresponds geographically to a vegetation and land use file. The files have been used concurrently to characterize the land surface in the Goddard Institute for Space Studies Global Climate Model (GISS GCM).

I. Ground Hydrology and Global Climate Modeling

The inclusion of realistic ground surface hydrologic parameters in global climate models improves the sensitivity of simulation experiments of energy and moisture exchanges between the land and the atmosphere. Model inputs require geographic data on four land surface components: soil, surficial geology, plant litter, and vegetative cover. Of these, the soil is the major partitioning agent of moisture receipts because it strongly influences infiltration, runoff, storage, and drainage, and, in addition, plant-litter ground cover development.

Current global climate models use two versions of a bucket model which simplify natural vertical and horizontal inhomogeneities: (1) pure bucket model, in which a maximum water holding capacity depth is assigned (Manabe, 1969); (b) a 2-layer bucket, in which the water holding capacity depth is allocated to two interacting layers, (Hansen et al., 1983; Mahert and Pan, 1984; Manabe, 1969). Manabe and Wetherald (1986) assumed that the moisture holding capacity was "constant everywhere in view of our ignorance of its geographical distribution and because the simulated distribution of soil moisture expressed as a fraction of the moisture-holding capacity of soil is not very sensitive to the magnitude of the field capacity." In fact, however, the geographic distribution of soil moisture holding capacity is well known; the difficulty lies in the inability of global climate models to capture and to respond to soil variability. Experiments with general circulation models show strong gross climate responses to changes in simplified ground model moisture levels (Fennessey and Sud, 1983; Houghton, 1984; Manabe and Wetherald, 1986; Nappo, 1975; Rind, 1982, 1984; Rowntree and Boltan, 1983; Shukla and Mintz, 1982; Walker and Rowntree, 1977). Some designers of atmospheric circulation models recognize the need for a more realistic parameterization of the complex physical processes occurring at the land-atmosphere interface in order to incorporate soil variability (Eagleson, 1981; Houghton, 1984). Eagleson (1978) and Dickinson (1984) have suggested general analytical frameworks for coupling the atmosphere-plant-litter-soil-rock-water system.

To realistically describe the four ground surface components, the complete geography of the land regions of the world must be digitized at a taxonomic level conformal with the spatial scale of the atmospheric model. There is an inverse information trade-off between taxonomic level and ground surface detail. The soil file should not deliver more data than the circulation model can absorb or less than it requires; within this range greater realism enhances experimental results. Given reasonable conformality between taxonomic level and grid cell size, the rectangular volume of a four-component ground surface cell with known X, Y, and Z dimensions may be taken as the elemental control unit of water flow through a porous medium. The equation of hydrologic continuity can be solved by using the governing equation of each component to trace the flux through the entire porous land surface and to the atmosphere.

This report describes the development, structure, and limitations of a world soil file of 15,413 records obtained from the Soil Map of the World, 1:5,000,000, Food and Agriculture Organization, United Nations, FAO-UN, (1974). Substratum properties may be inferred from the soil profile. When linked to the locationally correspondent Matthews vegetation and land use file (Matthews, 1982, 1984), the two files can be coupled to global atmospheric circulation models. The files were prepared for use with the Goddard Institute for Space Studies Global Climate Model, GISS GCM. Data in the files are recorded for 1° x 1° cells; characteristics are numerically aggregated for 8° x 10° and 4° x 5° runs. The one degree cells of the soil file contain information on dominant, associated, and included soil units, as defined by the FAO-UN classification. The Matthews and soil files have wide utility and may be used jointly or separately to evaluate the impact of climate change on regional human activities dependent on soil water, ground water, and stream flow, as agriculture, forestry, grazing, urban water supply, hydropower, and related flood, erosion, and pollution hazards.

II. The Soil Data File

Climate models require data on soil characteristics that influence climate parameters, characteristics such as texture, structure, depth, permeability, porosity, mineralogy, color, etc. The object of the world soil data file is to identify spatially (horizontally and vertically) and quantitatively, these hydraulic properties.

The file data were extracted from FAO Soil Map of the World (1974-1981), scale 1:5,000,000. A set of explicit operating rules was followed in gathering the data. A land cell is defined as 1° x 1° area occupied by ≥50 percent land. Land glaciers are included in land cells but inland bodies of water are water cells if water occupies >50 percent of the cell area. Inland water cells, ocean cells, and sea ice cells are excluded from the file. The land cells can conform exactly in type, location, and number to the land cells of the Matthews vegetation and land use file (Matthews, 1982, 1984).

Each one degree cell is identified by the latitude and longitude of its northwest corner. Latitudes north of the equator are positive and south of the equator are negative. Longitudes east of the prime meridian are positive and west of the prime meridian are negative. The source map was published with a two degree grid system over most of its area. Between the 60th parallel and the 80th parallel, the grid lines are four degrees apart, and poleward of the 80th parallel, the interval is eight degrees. One degree cells were obtained by using a transparent overlay to subdivide the published grid. As shown by Fig. 1, the dash lines delineate the boundaries of the one-degree cell, the northwest corner of the cell of interest and poleward of the 80th parallel, the interval is eight degrees. One degree cells were obtained by using a transparent overlay to subdivide the published grid. As shown by Fig. 1, the dash lines delineate the boundaries of the one-degree cell, the northwest corner of the cell of interest is latitude 36° north and longitude 81° west. On the source map of Fig. 1, the cell is subdivided into three map units. A map unit bounds an area of common soil units plus texture class plus slope class. When any one of these three characteristics changes, a new map unit is required. The largest map unit is Lc5-3a. The dominant soil unit in this map unit is Lc, which, as shown in Fig. 1, is a Chromic luvisol. A soil unit is the most basic unit of soils in the FAO classification system. Soil units differ from one another because of their inherent composition. The members of a map unit are a dominant soil unit and associated soil units. The associated soil units are decomposed further according to relative area into associated and (less abundant) included soil units, which occupy smaller areas than the associated soil unit. In this map unit, the other soil unit, indicated by the number 5, refers to a Chromic Vertisol; no included soil unit is present. The alphanumeric legend is defined in the FAO Soil Map of the World, volume 1. Thus, the enclosed area of a map unit bounds one or several soil units, forming a natural landscape of dominant, associated, and included soil units that are spatially and pedologically related.

The soil units are arranged in a classification system based on inherent profile properties. The FAO system has two levels. The highest level has 26 members; the lowest level has 106 members or soil units.* Table 1 lists the soil names at both levels. Detailed profile descriptions containing information on texture, structure, color, natural soil layers, total depth, layer thickness, and underlying geologic material for the soil units at designated locations are given in the volume accompanying each map. The profile description is representative of the soil unit. The total number of map units made up of real world combinations of soil units "occurring within the limits of a mappable physiographic entity as recorded on the source map is estimated to be 5000" (FAO 1974-1981).

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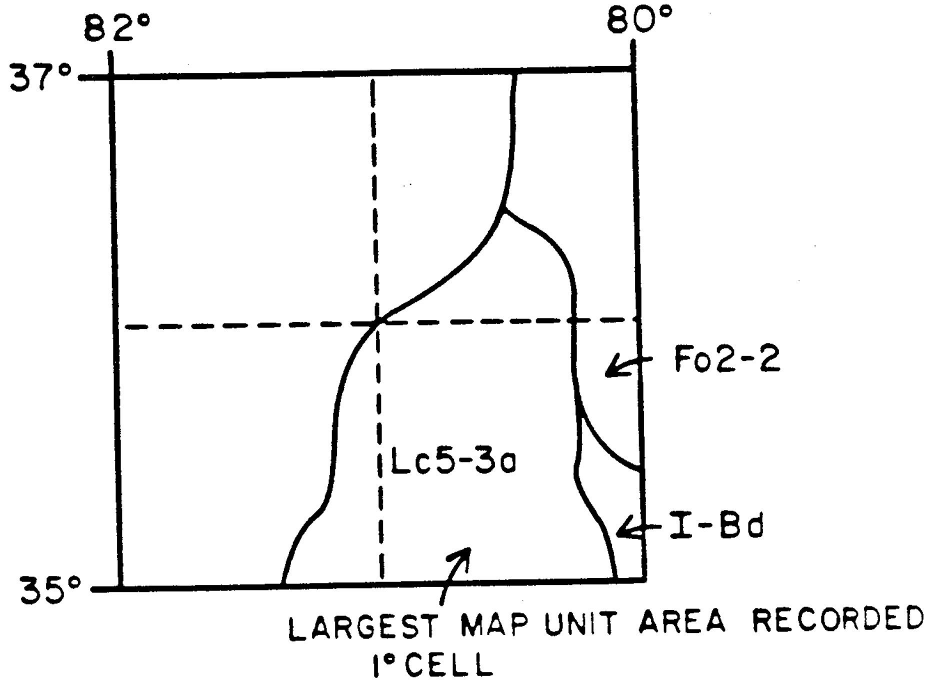
*The United States Department of Agriculture, Soil Conservation Service, basic system of soil classification taxonomy has six levels, order, suborder, great group, subgroup, family, series (SCS-USDA, 1975). The lower level of the FAO classification is approximately equivalent to the great group taxon, but the relation between specific members of the two taxa is not unique.

Scale 1:5,000,000
Digitization of 1° Cells



Map Unit - Lc5-3a

Soil Association -- Lc5 -- Association of Soils on Landscape
Lc -- Dominant Soil Unit, Chromic Luvisol
5 -- Associated and Included Soil Unit, Chromic Vertisols

Texture Class -- 3 -- Texture Class of Dominant Soil

Slope Class -- a -- Slope Class

Fig. 1 FAO-UNESCO SOIL MAP OF THE WORLD

Table 1: SOIL CLASSIFICATION UNITS, FOOD AND AGRICULTURAL ORGANIZATION, UNITED NATIONS, SOIL MAP OF THE WORLD

Soil Units

J	FLUVISOLS
JE	Eutric Fluvisols
JC	Calcaric Fluvisols
JD	Dystric Fluvisols
JT	Thionic Fluvisols
G	GLEYSOLS
GE	Eutric Gleysols
GC	Calcaric Gleysols
GD	Dystric Gleysols
GM	Mollic Gleysols
GH	Humic Gleysols
GP	Plinthic Gleysols
GX	Gelic Gleysols
R	REGOSOLS
RE	Eutric Regosols
RC	Calcaric Regosols
RD	Dystic Regosols
RX	Gelic Regosols
I	LITHOSOLS
Q	ARENOSOLS
QC	Cambic Arenosols
QL	Luvic Arenosols
QF	Ferralic Arenosols
QA	Albic Arenosols
E	RENDZINAS
U	RANKERS
T	ANDOSOLS
TO	Ochric Andosols
TM	Mollic Andosols
TH	Humic Andosols
TV	Vitric Andosols
V	VERTISOLS
VP	Pellic Vertisols
VC	Chromic Vertisols
Z	SOLONCHAKS
ZO	Orthic Solonchaks
ZM	Mollic Solonchaks
ZT	Takyric Solonchaks
ZG	Gleyic Solonchaks
S	SOLONETZ
SO	Orthic Solonetz
SM	Mollic Solonetz
SG	Gleyic Solonetz
Y	YERMOSOLS
YH	Haplic Yermosols
YK	Calcic Yermosols
YY	Gypsic Yermosols
YL	Luvic Yermosols
YT	Takyric Yermosols
X	XEROSOLS
XH	Haplic Xerosols
XK	Calcic Xerosols
XY	Gypsic Xerosols
XL	Luvic Xerosols
K	KASTANOZEMS
KH	Haplic Kastanozems
KK	Calcic Kastanozems
KL	Luvic Kastanozems
C	CHERNOZEMS
CH	Haplic Chernozems
CK	Calcic Chernozems
CL	Luvic Chernozems
CG	Glossic Chernozems
H	PHAEOZEMS
HH	Haplic Phaeozems
HC	Calcic Phaeozems
HL	Luvic Phaeozems
HG	Gleyic Phaeozems
M	GREYZEMS
MO	Orthic Greyzems
MG	Gleyic Greyzems

Table 1 (cont'd.)

B	CAMBISOLS
BE	Eutric Cambisols
BD	Dystric Cambisols
BH	Humic Cambisols
BG	Gleyic Cambisols
BX	Gelic Cambisols
BK	Calcic Cambisols
BC	Chromic Cambisols
BV	Vertic Cambisols
BF	Ferralic Cambisols
L	LUVISOLS
LO	Orthic Luvisols
LC	Chromic Luvisols
LK	Calcic Luvisols
LV	Vertic Luvisols
LF	Ferric Luvisols
LA	Albic Luvisols
LP	Plinthic Luvisols
LG	Gleyic Luvisols
D	PODZOLUVISOLS
DE	Eutric Podzoluvisols
DD	Dystric Podzoluvisols
DG	Gleyic Podzoluvisols
P	PODZOLS
PO	Orthic Podzols
PL	Leptiv Podzols
PF	Ferric Podzols
PH	Humic Podzols
PP	Placic Podzols
PG	Gleyic Podzols
W	PLANOSOLS
WE	Eutric Planosols
WD	Dystric Planosols
WM	Mollic Planosols
WH	Humic Planosols
WS	Solodic Planosols
WX	Gelic Planosols
A	ACRISOLS
AO	Orthic Acrisols
AF	Ferric Acrisols
AH	Humic Acrisols
AP	Plinthic Acrisols
AG	Gleyic Acrisols
N	NITOSOLS
NE	Eutric Nitosols
ND	Dystric Nitosols
NH	Humic Nitosols
F	FERRALSOLS
FO	Orthic Ferralsols
FX	Xanthic Ferralsols
FR	Rhodic Ferralsols
FH	Humic Ferralsols
FA	Acric Ferralsols
FP	Plinthic Ferralsols
O	HISTOSOLS
OE	Eutric Histosols
OD	Dystric Histosols
OX	Gelic Histosols

The geographic pattern of a soil unit expresses the localized factors of soil genesis. An appreciation of the spatial relationship among soil units and map units is important to the use of the data extracted from the source map and recorded in the file. As Fig. 1 shows, a given cell may be occupied by more than one map unit. In that case the one degree cell is characterized by the map unit covering the largest area. For a given map unit the dominant soil unit occupies the largest area of the map unit. The associated soil unit occupies more than 20 percent of the enclosed map unit area but less than the area of the dominant soil unit; the included soil unit occupies less than 20 percent of the enclosed area. The file records the dominant soil unit of the largest map unit; the associated and included soil units are recorded in the file by a numeric code which is referenced on the back of the FAO source map sheets.

The total area of each map unit association on each map sheet is given in the text accompanying the map sheets, but the area of each soil unit is not available. The one degree grid units of the soil file record the associated and included soil units associated with the dominant soil unit, but contain no information on soil unit area. However, FAO has developed an algorithm for estimating the area of each soil unit within a soil association based on the number of soil units in each map unit. The method is applicable to the largest map unit association in each one degree grid cell (FAO, 1978). Table 2 illustrates the procedure.

Surface slope and surface soil texture, when available, are part of the complete map unit symbol, which also includes the textural class of the dominant soil unit, and the slope class of the soil map unit association.

The textural class of a soil map unit association is for the upper 30 centimeters of the dominant soil. It represents the relative proportions of clay (2 microns), silt (2-50 microns), and sand (50-2000 microns). The three classes are named:

1) coarse textured -- sands, loamy sands, and sandy loams with less than 18 percent clay, and more than 65 percent sand. No further definitions are given within the same range.

2) medium textured -- sandy loams, loams, sandy clay loams, silt loams, silt, silty clay loams, and clay loams with less than 35 percent clay and less than 65 percent sand. The sand fraction in this class may have a maximum of 82 percent if there is a minimum of 18 percent clay.

3) fine textured -- clays, silty clays, sandy clays, clay loams, and silty clay loams with more than 35 percent clay. The map unit soil association symbol for textural class often shows varying combinations of the three basic classes so that seven textural classes are possible for mineral soils, as (1,2), (1,3), (2,3), (1,2,3) in addition to (1), (2), (3).

Table 2: RELATIVE DISTRIBUTION OF DOMINANT SOIL, ASSOCIATED SOIL(S) AND INCLUSION(S) EXPRESSED IN PERCENTAGE OF THE AREA OF THE MAPPING UNITS (FAO, 1978)

Dominant soil	Associated soil(s)		Inclusion(s)	
Percentage of area	Number of soil units	Percentage of area	Number of soil units	Percentage of area
100	0	0	0	0
70	1	30	0	0
60	1	30	1	10
60	2	20+20	0	0
50	2	20+20	1	10
30	3	20+20+20	1	10
50	1	30	2	10+10
40	1	30	3	10+10+10
50	1	30	4	5+5+5+5
40	2	20+20	2	10+10
30	2	20+20	3	10+10+10
30	3	20+20+20	2	5+5
25	3	20+20+20	3	5+5+5
24	3	20+20+20	4	4+4+4+4

The associations dominated by Lithosols were allocated a slightly different distribution, namely:

Litnosol + associated soil: 1/2 + 1/2 distribution of the area
Lithosol + associated soil: 1/3 + 1/3 + 1/3 distribution of the area

1 COARSE
%
9 clay
8 silt
83 sand

2 MEDIUM
%
30 clay
33 silt
37 sand

1,2 COARSE-MEDIUM
%
20 clay
20 silt
60 sand

1,2,3 COARSE-MEDIUM-FINE
%
35 clay
19 silt
46 sand

3 FINE
%
67 clay
17 silt
17 sand

1,3 COARSE-FINE
%
38 clay
12 silt
50 sand

2,3 MEDIUM-FINE
%
48 clay
25 silt
27 sand

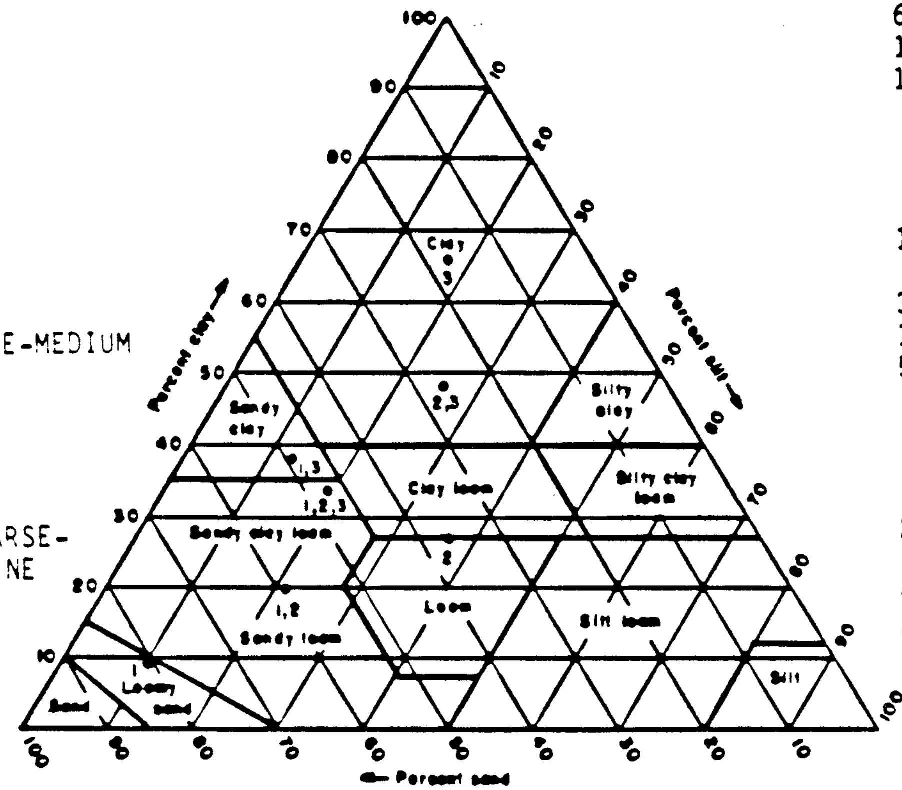


Fig. 2 Location of FAO Textural Classes on Texture Triangle Used in World Soil File

The position of each of these seven classes is shown on the tri-axial sand, silt, clay texture triangle with the boundaries of the commonly-used U.S. Department of Agriculture texture class names, Fig. 2. The centroid of each FAO texture class was determined geometrically, using the means of the given value ranges to locate the three basic classes. The means of the basic classes were used to locate the mixed classes. An additional "texture" class was added for organic soils.

Textural class applies to the dominant soil unit of the map unit. The ambiguity of the textural class designation is evident from the frequent use of multiple legend codes on the source map. FAO interpretation guidelines state that when two textural classes are recorded, each applies to 50 percent of the dominant soil unit. Similarly, if three texture classes are shown, each applies to 33.3 percent of the dominant soil unit. The area guidelines are of limited use to evaluate water flux at climate modeling resolution. Also, dominant soils of mapping units whose textures are not given for the map unit, FAO prescribes as medium textured. These FAO rules are used for the 106 soil units, except for 10 soil units which default to coarse, and for 7 soil units, which default to fine. Because the FAO rules are too cumbersome to apply to atmosphere modeling, the file records of soil texture for multiple textural classes were obtained from the soil texture triangle after averaging multiple values. (See Fig. 2). File records for areas with no texture class given were derived from adjacent soil unit texture class and regional geology.

Three basic classes are used to describe the surface slope of the area of a soil map unit association. They are (1) 0-8 percent, level to gently undulating, (2) 8-30 percent, rolling to hilly, (3) 30 percent, steeply dissected to mountainous. The soil map unit association legend often describes the slope as combinations of the basic slopes, so that seven possible categories exist, (1,2), (1,3), (2,3), (1,2,3), and (1), (2), (3). Multiple class slopes were determined from the averages of the basic slope classes and entered into the file.

Slope evaluations are treated on the FAO source map similar to textural class. FAO interpretation guidelines state that the slope class applies to the dominant soil of the map unit; if two or more classes are indicated each occupies an equal area of the dominant soil unit. Where slope is not described for a dominant soil unit, slope classes are allocated according to the 26 major categories of soil units (see Table 1); some of the allocations include two slope classes. Slope classes also apply to associated and included soil units. File records of slope for multiple classes were obtained by averaging the given slopes. For missing slope classes the data file class was derived from geomorphic evidence and adjacent map unit designations.

Additional ground surface information of climatic interest is provided by the FAO map as overprints apart from the soil map unit association. These are phases and miscellaneous land units. Phases are subdivisions of soil units which have not been systematically recorded and, hence, are not diagnostic for the separation of the soil units. Nevertheless, phases do provide important data. They are:

stony phase, presence of coarse material on the surface, as gravel, stones, boulders, rock outcrop, which may be used to modify the texture;

lithic phase, presence of hard rock within 50 centimeters of the surface;

petric phase, presence of hardened material at least 2 centimeters thick, occurring within 100 centimeters of the surface, but not continuously distributed;

petroferric phase, upper part of petroferric horizon which is a continuously distributed horizon of iron cemented indurated material containing little or no organic matter;

petrocalcic phase, upper part of a cemented or indurated calcic horizon cemented by calcium or magnesium carbobate occurs within 100 centimeters ofthe surface;

petrogypsic phase, upper part of a cemented gypsuum layer cemented by calcium sulphate occurs within 100 centimeters of the surface;

phreatic phase, a ground water table is present, at a depth of 3-5 meters below the surface, but usually does not affect the morphology of the soil. Its presence, however, may influence soil water flow;

fragipan phase is a soil horizon of low permeability and coarse texture that occurs within 100 centimeters of the surface;

duripan phase is a silica cemented soil layer of low permeability occurring within 100 centimeters of the surface;

saline and sodic phases are soils that show in some horizons high contents of salts (saline) or of sodium (sodic) which affects hydraulic potentials;

permafrost and intermittent permafrost -- continuous and intermittent areal distribution of year-round frozen substrata.

Other land surface characteristics not included in any of the above are also shown on the source map as overprints for miscellaneous land units. These land units contain climatically important information recorded by the soil file for dunes or shifting sands, glaciers, salt flats, rock debris or detritus, and flooding, or ponding. They are represented with and without soil units. In the latter case, physical properties were assigned to the cells; if the soil unit was given, the physical properties recorded for the soil were modified to reflect the presence of the special features. The soil file records phases and miscellaneous land units for appropriate cells, as shown in Table 3.

Table 3: PHASE AND MISCELLANEOUS LAND UNIT LEGEND

Number	Explanation
01	stony
02	lithic
03	petric
04	petroferic
05	petrocalcic
06	petrogypsic
07	fragipan
08	duripan
09	saline
11	phreatic
12	cerrado
13	sodic
21	permafrost
22	intermittent permafrost
23	glacial
24	ponded
25	dunes, sands
26	rock debris
27	salt flats

The use of a special code field in the soil file indicates the cells with differences between the Matthews vegetation file and the FAO source map in their designations of land glacial cells and soil cells. The special code field also notes the cells to which supplemental data were added because the FAO source map provided insufficient information to characterize the ground surface. Table 4 gives the special code legend which enables the user to obtain several output soil files such as, a file whose soil cells are selected according to Matthews, a file whose soil cells are selected according to FAO (with or without supplemental data), a file whose soil cells are determined by Matthews and FAO data, using either source to characterize the cell as having a soil or a glacier. (The former choice maximizes the number of soil cells.) All output files may be used with the Scripps Topographic file (Gates and Nelson, 1975).

The explanatory volumes accompanying the source map include material on geomorphology, geology and climate, as aides to the prescription of soils. This information is useful in defining the lower boundaries of soils. A list of the recorded ground surface physical features needed to characterize soil climatic properties of the one degree cells is given by Table 5. An annotated format of selected cell records is shown in Table 6.

III. Limitation of the Soil Data File

The information entered into the soil data file was extracted from a secondary source, FAO Soil Map of the World, 1:5,000,000. The ability of the file to depict soil physical features of the real world cannot go beyond the source map and the accompanying text. Several limitations to the use of the soil file in addition to those mentioned previously in the discussion of map units, soil units, texture and slope, are given in this section.

The FAO Soil Map of the World was compiled over a 15-year period using information from soil reports of field surveys and map collections of soils, geology, topography, vegetation, and climate, and field checking. About 11,000 maps were reviewed; they varied widely in reliability, detail, precision, scales, methodologies, etc. (FAO, 1978). The source maps are ranked according to three levels of reliability as I, systematic surveys, II, reconnaissance surveys, and III, general information surveys. These general levels of reliability were not considered in the construction of the soil file, nor, were the reliability estimates incorporated in the file. Table 7 summarizes the reliability (Gardiner, 1982).

Table 4: SPECIAL CODE LEGEND

Code Number	Explanation
33	1° cell not on FAO source map but included in Matthews vegetation file as having a vegetative cover; map unit data added to soil file.
44	1° cell not on FAO source map but included in Matthews vegetation file as a glacier; added to soil file as a glacial cell.
55	1° cell on FAO source map as a soil but described as a glacial cell in Matthews vegetation file; map unit data recorded in soil file
66	1° cell described as glacial on FAO source map, but included in Matthews Vegetation file as a vegetation cell; map unit data added to soil file
77	slope not given on FAO source map; slope class added to soil file
88	texture not given on FAO source map; texture added to soil file
99	map unit not given on FAO source map; miscellaneous land unit used to assign map unit data to cell

Table 5: LAND SURFACE SOIL-CLIMATE PHYSICAL FEATURES

TEXTURE, particle size distribution of soil horizon

STRUCTURE, particle size arrangement and compactness of soil horizon

POROSITY, the fraction of the bulk volume of the soil or substratum not occupied by solid material caused by voids among individual particles, solution cavities, or joints and fractures

PROFILE, overall arrangement of soil layers and horizon, defines the soil pedon or individual

COLOR, Munsell color notation, hue, value, chroma

GLACIERS, snow accumulations on ground surface, year round

DUNES, unconsolidated structureless sand size particle on ground surface

ROCK DEBRIS, coarse fragment larger than sand size on ground surface

SALT FLAT, accumulation of salt on the ground surface as residual evaporation from saline surface water or ground water

SLOPE, inclination of the ground surface

ASPECT, compass direction toward which a sloping ground surface faces

DEPTH, vertical thickness of the ground surface or a part thereof as soil horizons

DRAINAGE, the movement of excess water (gravity water) from the soil or ground surface and within the soil

PARENT MATERIAL OF SOIL, inorganic or organic material from which the soil was derived

GEOMORPHIC POSITION, location of the soil (or other feature of the ground surface) as part of the landscape

SUBSTRATUM, lithology and structure of mineral (or organic) material underlying the soil

STONINESS, presence of gravel, stones, boulders or rock outcrop on the surface

HISTIC H HORIZON, surface layer of organic material more than 20 cm thick

MOLLIC A HORIZON, surface horizon with dark color, medium to high humus content, high base saturation

Table 5 (cont'd.)

UMBRIC A HORIZON, surface horizon with dark color, medium to high humus content, low base saturation

OCHRIC A HORIZON, surface horizon with light color, low humus content

ARGILLIC B HORIZON, subsoil horizon with accumulation of illuvial clay

NATRIC B HORIZON, subsoil horizon with accumulation of illuvial clay and high exchangable sodium

CAMBRIC B HORIZON, subsoil horizon with a structure and/or color different from overlying and underlying horizons

CALCIC HORIZON, horizon of accumulation of calcium carbonate

GYPSIC HORIZON, horizon of accumulation of calcium sulphate

ALBIC E HORIZON, eluvial horizon from which clay and free iron oxide have been removed, light color

CRACKING CLAYS, formaton of deep and wide cracks upon drying

PERMAFROST, permanently frozen layer immediately beneath soil; continuous or intermediate distribution

FROZEN LAYER, seasonally frozen solum, partially or wholly

PLINTHITE, iron mottled fine textured subsoil layer which irreversibly hardens upon repeated wetting and drying

IRON CONCRETIONS, nodules of iron oxide dispersed through the soil

LITHIC, continuous hard rock on, or close to, ground surface

INDURATED SUBSOIL, subsoil layer with very firm or hard consistence, which can be penetrated by spade or auger

CEMENTED HARDPAN, extremely hard continuous subsoil layer which cannot be penetrated by spade or auger

DURIPAN, silica cemented layer close to surface

FRAGIPAN, compacted dense layer of coarse fragments close to surface

SALINITY or ALKALINITY, dissolved salts or exchangeable bases, in soil water, raising the pH well above the neutral point

Table 6: SOIL FILE FORMAT OF 1° x 1° CELL RECORD

SEQUENCE NO.	LAT	LONG	DOMINANT SOIL UNIT	ASSOC. INCLUDED SOIL UNIT	TEXTURE CLASS	SLOPE CLASS	MISC. LAND UNIT PHASE	SPECIAL CODE	FAO MAP SHEET
1752.	80	-88	RX	1	2	C	21 23	55	NAM
1753.	80	-87	RX	1	2	C	21 23	55	NAM
3175.	63	-68	RX	2	1	B	1 21		NAM
3176.	63	-67	RX	2	1	B	1 21		NAM
3178.	63	-49					23	44	NAM
3179.	63	-48					23	44	NAM
3411.	59	-137	PO	9	2	BC	1 22 23	55	NAM
3412.	59	-136	PO	9	2	BC	1 22 23	55	NAM
3413.	59	-135	PO	9	2	BC	23 1 21	66	NAM
3414.	59	-134	I	R B	1	BC	22 23	55	NAM
3945.	51	-118	PO	10	12	C	1 22		NAM
3946.	51	-117	I	R B	1	C	22		NAM
3976.	51	-87	PO	10	1	B	1		NAM
3977.	51	-86	OD	1	9	A		88	NAM
3978.	51	-85	OD	1	9	A	24	88	NAM
3979.	51	-84	OD	8	3	A	1		NAM
3980.	51	-83	OD	8	3	A	1		NAM
3981.	51	-82	OD	1	9	A	24	88	NAM
3982.	51	-81	GE	15	3	A			NAM
3983.	51	-80	OD	9	123	A			NAM
3984.	51	-79	OD	9	123	A			NAM
3985.	51	-78	OD	9	123	A			NAM
4212.	47	-97	GM	6	3	A	24		NAM
4213.	47	-96	CH	2	1	A			NAM
4214.	47	-95	LO	20	2	A	7		NAM
4215.	47	-94	LO	20	2	A	7		NAM
4216.	47	-93	DE	3	2	AB	24		NAM
4217.	47	-92	PO	20	1	AB			NAM
4218.	47	-91	PO	13	1	B	1 24		NAM
4612.	39	-119	YL	14	2	AB	1		NAM
4613.	39	-118	YL	14	2	AB	1		NAM
4614.	39	-117	YM	8	2	AC	2		NAM
4615.	39	-116	YL	3	2	AC	8		NAM
6684.	20	51	R		1	AB	25	99	SAS
10551.	74	86	I	RXOX	2	BC	21	33	EUR
13569.	19	-11	I		1	AB	26 25	77 88	AFR

Table 6 Notes

Sequence No.	Description
1753	Lat. 80N, Long 87W; dominant soil unit -- Gelic Regosol; associated and included soil unit -- none; texture class -- medium; slope class -- steeply dissected to mountainous; phase and misc. land unit -- permafrost, glacial; special code -- soil on FAO map, glacier on Matthews vegetation file; FAO map sheet -- North America
3176	Lat. 63N, Long. 67W; dominant soil unit -- Gelic Regosol; associated and included soil units -- lithosol and gelic gleysol; texture class -- coarse; slope class -- rolling to hilly; phase and misc. land unit -- stony phase and permafrost; special code -- Map and Matthews vegetation file agree; FAO map sheet -- North America
3179	Lat. 63N, Long. 48W; no soil unit present; texture class and slope class not given; phase and misc. land unit -- glacier; special code -- cell not on FAO map, cell in Matthews vegetation file is glacial; FAO map sheet -- North America
3413	Lat. 59N, Long. 135W; dominant soil unit -- Orthic Podzol; associated and included soils -- histosol, vitric andosol; texture class -- medium; slope class -- rolling to hilly and steeply dissected to mountainous; phase and misc. land unit -- stony, glacial, permafrost; special code -- glacial on FAO Map but soil in Matthews vegetation file; FAO map sheet -- North America
3945	Lat. 51N, Long. 118W; dominant soil unit -- Orthic Podzol; associated and included soil units -- Lithosol; texture class; coarse and medium; slope class -- steeply dissected to mountainous; phase and misc. land unit -- stony and intermittent permafrost; special code -- none; FAO map sheet -- North America
3946	Lat. 51N, Long. 117W; dominant soil unit -- Lithosol; associated and included soil units -- Regosol and Cambisol; texture class -- course slope class -- steeply dissected to mountainous; phase and misc. land unit -- intermittent permafrost; special code -- none; FAO map sheet -- North America
3978	Lat. 51N, Long. 85W; dominant soil unit -- Dystric Histosol; associated and included soil units -- none; texture class -- organic; slope class -- level to gently undulating; phase and misc. land unit -- ponded; special code -- texture class not given on FAO map; FAO map sheet -- North America

Table 6 Notes (cont'd.)

Sequence No.	Description
3983	Lat. 51N, Long. 80W; dominant soil unit -- Dystric Histosol; associated and included soil units -- orthic podzol, dystric gleysol; texture class -- organic; slope class -- level to gently undulating and rolling to hilly and steeply dissected to mountainous; phase or misc. unit -- none recorded; special code -- none; FAO map sheet -- North America
4215	Lat. 47N, Long. 94W; dominant soil unit -- Orthic Luvisol; associated and included soil units -- dystric cambisol, glycic luvisol, gleysol; texture class -- medium; slope class -- level to gently undulating; phase and misc. land unit -- fragipan; special code -- none; FAO map sheet -- North America
4614	Lat. 39N, Long. 117W; dominant soil unit -- Haplic Yermosol; associated and included soil units -- calcaric regosol, calcic yermosol; texture class -- medium; slope class -- level to gently undulating and steeply dissected to mountainous; phase and misc. land unit -- lithic; special code -- none; FAO map sheet -- North America
6684	Lat. 20N, Long. 51E; dominant soil unit -- Regosol; associated and included soil units -- none given; texture class -- coarse; slope class -- level to gently undulating and rolling to hilly; phase and misc. land unit -- none given; special code -- dominant soil unit not given on FAO map; FAO map sheet -- South Asia
10551	Lat. 74N, Long. 56E; dominant soil unit -- Lithosol; associated and included soil units -- Gelic Regosol, Gelic Histosol; texture class -- medium; slope class -- rolling to hilly and steeply dissected to mountainous; phase and misc. land unit -- permafrost; special code -- grid cell not on FAO map but in Matthews vegetation file; FAO map sheet -- Europe
13569	Lat. 19N, Long. 11W; dominant soil unit -- Lithosol; associated and include soil units -- none given; texture class -- coarse; slope class -- level to gently undulating and rolling to hilly; phase and misc. land unit -- dune and rock debris; special code -- slope and texture classes not given on FAO map; FAO map sheet -- Africa.

Table 7: RELIABILITY OF THE SOIL MAP OF THE WORLD[1]

Soil Survey Coverage (percent)

	Class I	Class II	Class III
Africa	7.5	38.0	54.5
Asia	19.0	49.0	32.0
Australasia	11.0	61.0	32.0
Europe	76.3	23.7	-
North & Central America	28.0	16.0	56.0
South America	14.6	45.9	39.5
World	21.0	40.0	39.0

[1]Gardiner (1982) After R. Dudal, 1978

NOTES: Class I represents those areas where systematic field surveys have been carried out whereas in Class II and III areas, soil boundaries have been derived from interpretation of general information on landforms, geology, climate and vegetation, and from scattered soil studies. It appears that only about one fifth of the worlds soils have been surveyed, the highest coverage being in Europe and the lowest in Africa. The information for China was supplied by the Soils Institute of Nanking and is therefore, realistic and reflects the knowledge acquired in the country itself (II).

In order to describe the profile properties of a soil unit beyond the surficial information given on the source map (soil unit name, texture class, slope class, phase and miscellaneous land unit), it is necessary to consult the profile description in the volumes accompanying the maps. The profile descriptions contain information needed to parameterize the physical properties of the lower soil horizons and the substratum for use in the governing equations. The profile descriptions are records of observations made on representative soil profiles at specific locations. Profile descriptions may not be available in the corresponding map sheet volume. The missing descriptions usually can be found in another volume. For example, the map of North America has 75 soil units, but the accompanying text has profile descriptions for 50 soil units. There are serious doubts about the spatial extrapolation of specific site profile descriptions to geographically distant areas, given the natural inhomogeneities of soils. At the high classification level of the soil unit in the FAO scheme, all regionally important unique soil and substrate climatic properties are not classification criteria. Thus, it is questionable if a profile description of a site in Puerto Rico is representative of the same soil unit in Washington.

A precise answer cannot be given to the question, "What is the resolution of the soil file?" Horizontal resolution is higher than a 4° x 5° grid cell and lower than at the level of a 1° x 1° cell for a soil unit; but it will vary geographically in different parts of the world, reflecting the uniformity of the spatial pattern of soil distribution and field survey reliability. The vertical resolution depends on the agreement between the subsoil property and the representative profile description of a soil unit for each parameter selected. Despite these difficulties, it should be possible to aggregate the mapping units into larger groups by focussing on the properties of land surfaces that influence atmospheric processes, as moisture storage, conductivity, slope, albedo (Gardiner, 1982).

IV. Use of the World Soil File, Examples of Output

The object of the file was to record the values of a selected set of geocoded soil parameters important for climate modeling. The file data set provides the basis of the spatial configuration of ground surface hydrologic and energy properties applicable to a global climate model. The user sets up the classification system according to his research needs and perceptions. The file data then are available to prescribe the physical equations governing water-energy-ground surface-atmosphere interactions according to a numeric scheme. The file can be updated as empirical information on soil behavior and field distributions of soil types are improved.

Several examples of tabular and map output obtainable from the file are given in Figures 3.1, 3.2 and 3.3, and Tables 8 and 9.

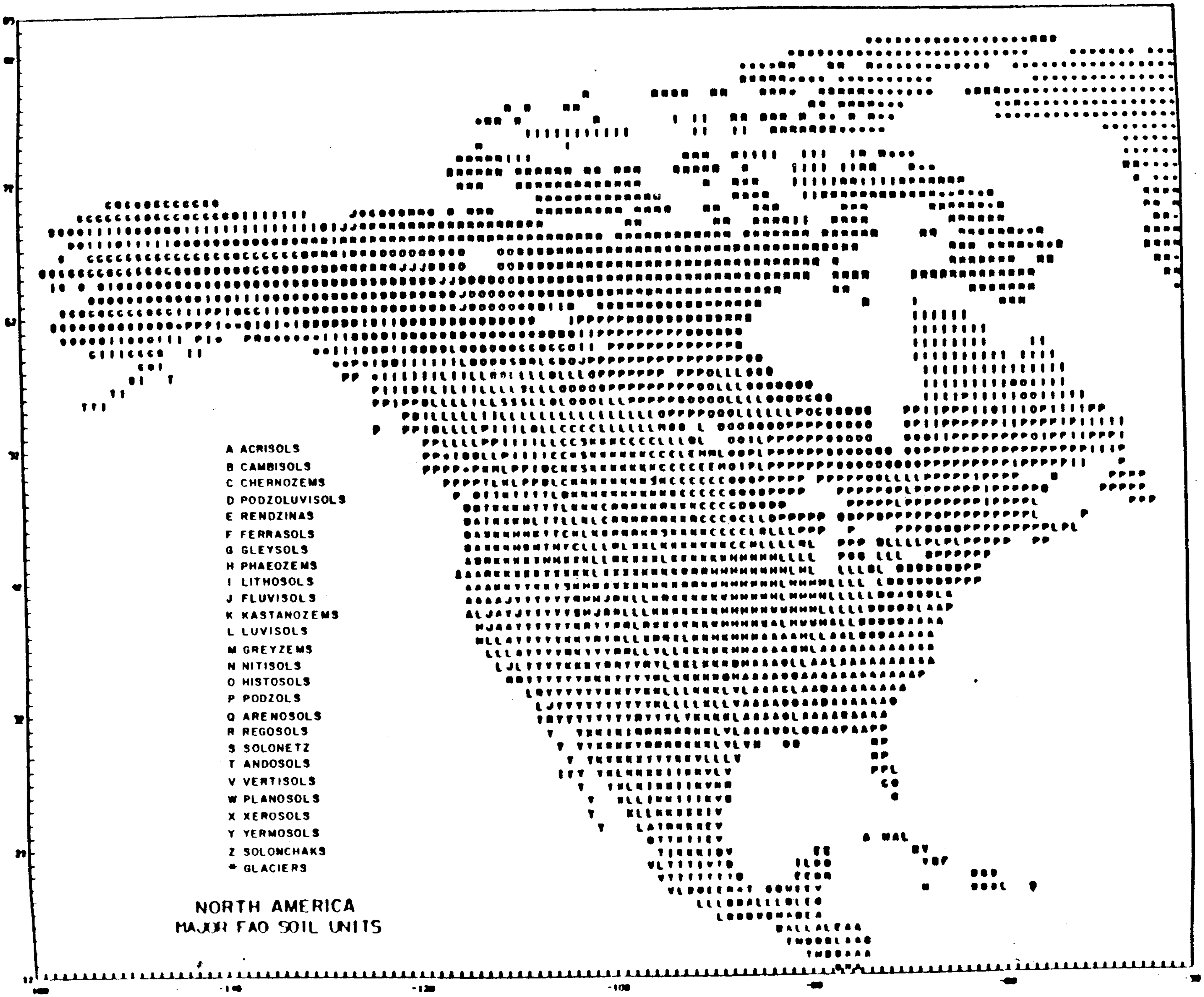


Fig. 3.1 Major FAO Soil Units, North America

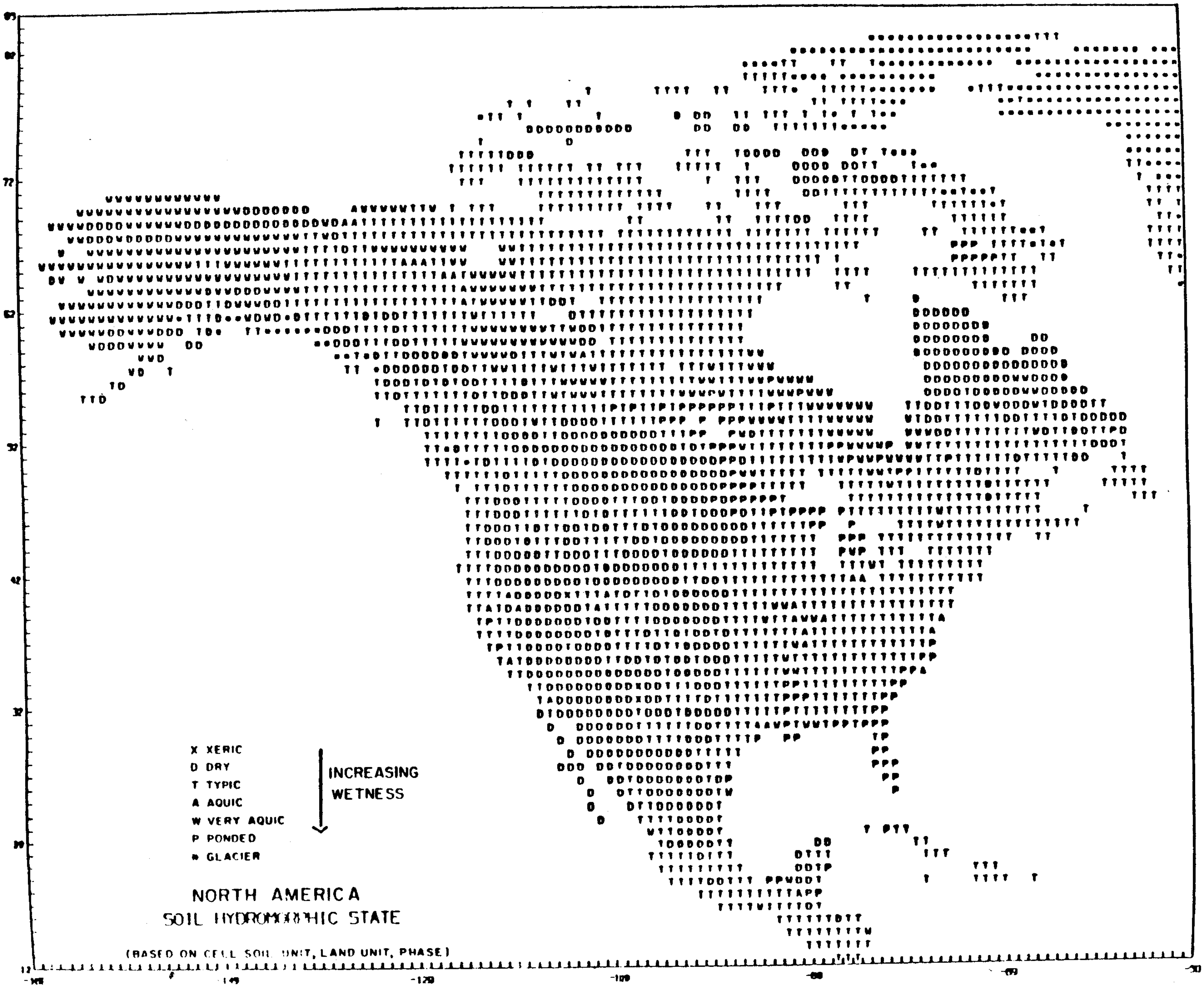


Fig. 3.2 Soil Hydromorphic State of 1° Cells, North America

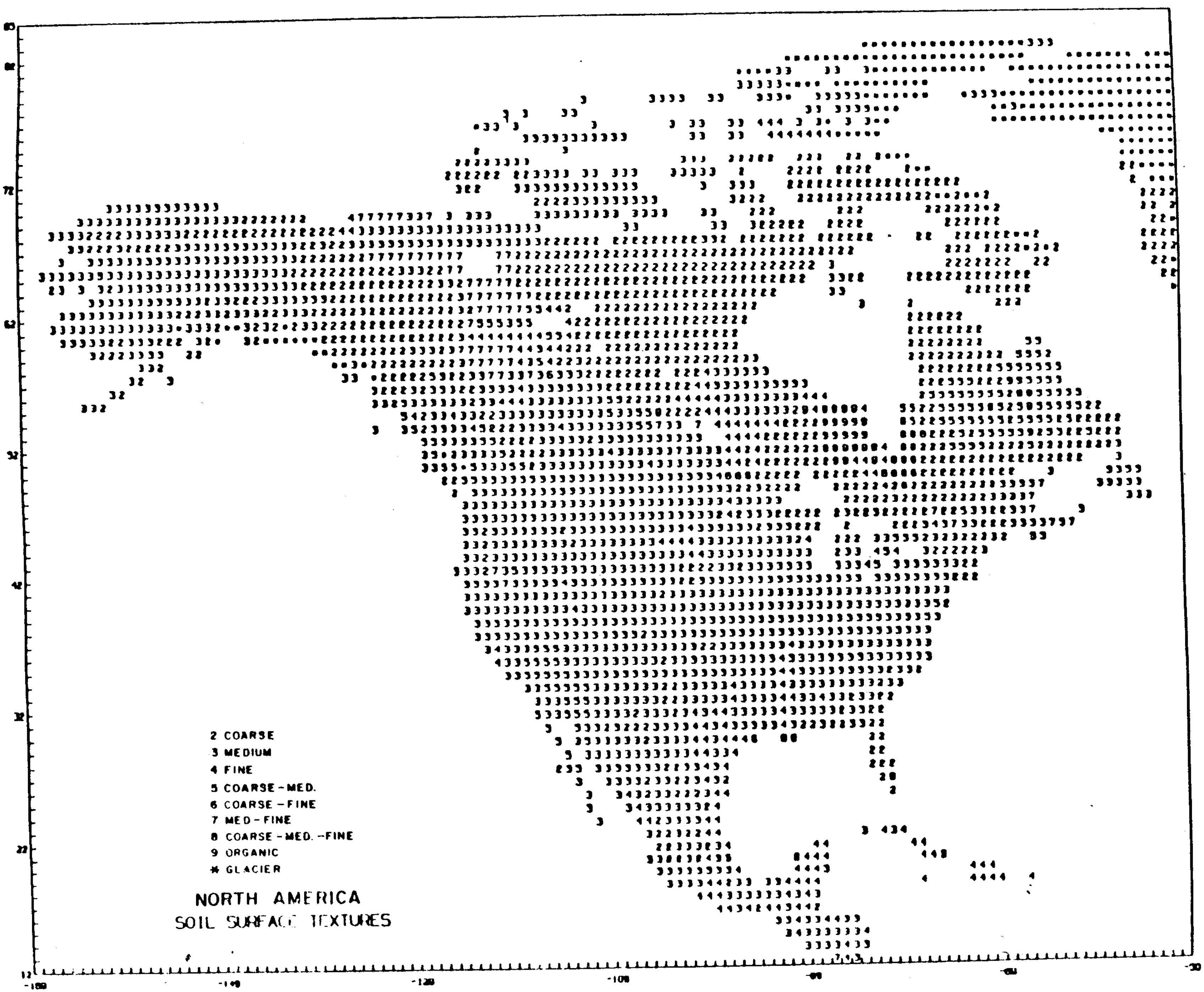


Fig. 3.3 Soil Surface Texture Classes of 1° Cells, North America

Table 8: SURFACE PROPERTIES OF A 10° LATITUDE BAND, 20°-30°N

Table 8.1: Soil, Ice, and Water Cells

MID-LAT. COORDS.	1 CELL AREA E+3KMSQ.	NO. SOIL CELLS	AREA SOIL E+3KMSQ	NO. ICE CELLS	AREA ICE E+3KMSQ	NO. WATER CELLS	AREA WATER E+3KMSQ
20.5	11.581	118.	1366.584	0.	0.000	242.	2802.656
21.5	11.504	121.	1391.968	0.	0.000	239.	2749.424
22.5	11.423	133.	1519.265	0.	0.000	227.	2593.031
23.5	11.339	134.	1519.468	0.	0.000	226.	2562.684
24.5	11.251	131.	1473.878	0.	0.000	229.	2576.473
25.5	11.160	142.	1584.687	0.	0.000	218.	2432.829
26.5	11.065	141.	1560.185	0.	0.000	219.	2423.265
27.5	10.967	149.	1634.109	0.	0.000	211.	2314.074
28.5	10.866	149.	1619.016	0.	0.000	211.	2292.700
29.5	10.761	154.	1657.231	0.	0.000	206.	2216.815
	10 DEGREE TOTAL:	1372.	15326.389	0.	0.000	2228.	24963.953

Table 8.2: "A" Horizon Texture Class of Selected Soil Unit, AO, Orthic Acrisol, as Percent of the 10° Band and of World Soil Area in Same Soil Unit

AO, ORTHIC ACRISOL

(AO occupies 137 1° cells in band with an area of 1528E+3 km^2 which is 9.97% of the total band soil area and is 25.52% of the AO soil unit area in the world and is 1.03% of the total soil area of the world)

ICE	COARSE	MEDIUM	
0.000	0.000	200.822	AREA OF CELLS, E+3 KMSQ
0.000	0.000	13.142	TXT CLASS AS PERCENT OF THIS SU IN 10° BAND
0.000	0.000	3.485	TXT CLASS AS PERCENT OF THIS SU IN WORLD
0.000	0.000	5.498	TXT CLASS AS PERCENT OF ALL SAME TXT IN 10° BAND
0.000	0.000	0.367	TXT CLASS AS PERCENT OF ALL SAME TXT IN WORLD
0.000	0.000	1.310	TXT CLASS AS PERCENT OF ALL ALL SU IN 10° BAND
0.000	0.000	0.135	TXT CLASS AS PERCENT OF ALL ALL SU IN WORLD
0.000	0.000	10.076	TXT CLASS AS PERCENT OF ALL SAME TXT, SAME SU IN WORLD

FINE	C-M	C-F	
804.201	0.000	0.000	AREA OF CELLS, E+3 KMSQ
52.629	0.000	0.000	TXT CLASS AS PERCENT OF THIS SU IN 10° BAND
13.956	0.000	0.000	TXT CLASS AS PERCENT OF THIS SU IN WORLD
30.961	0.000	0.000	TXT CLASS AS PERCENT OF ALL SAME TXT IN 10° BAND
3.770	0.000	0.000	TXT CLASS AS PERCENT OF ALL SAME TXT IN WORLD
5.247	0.000	0.000	TXT CLASS AS PERCENT OF ALL ALL SU IN 10° BAND
0.541	0.000	0.000	TXT CLASS AS PERCENT OF ALL ALL SU IN WORLD
56.112	0.000	0.000	TXT CLASS AS PERCENT OF ALL SAME TXT, SAME SU IN WORLD

M-F	C-M-F	ORGANIC	
523.040	0.000	0.000	AREA OF CELLS, E+3 KMSQ
34.229	0.000	0.000	TXT CLASS AS PERCENT OF THIS SU IN 10° BAND
9.076	0.000	0.000	TXT CLASS AS PERCENT OF THIS SU IN WORLD
50.984	0.000	0.000	TXT CLASS AS PERCENT OF ALL SAME TXT IN 10° BAND
5.201	0.000	0.000	TXT CLASS AS PERCENT OF ALL SAME TXT IN WORLD
3.413	0.000	0.000	TXT CLASS AS PERCENT OF ALL ALL SU IN 10° BAND

C-M, coarse medium; C-F, coarse fine; M-F, medium fine; C-M-F, coarse medium fine; SU, soil unit; TXT, texture (see text for explanation)

Table 9: SUMMARY OF CELL PROPERTY FREQUENCIES FOR NORTH AMERICA

TABLE 9.1: Soil Units

AF,	FERRIC ACRISOL	FREQ = 27	AG,	GLEYIC ACRISOL	FREQ = 12	AH,	HUMIC ACRISOL	FREQ = 10
AO,	ORTHIC ACRISOL	FREQ = 93	AP,	PLINTHIC ACRISOL	FREQ = 7	BC,	CHROMIC CAMBISOL	FREQ = 9
BD,	DYSTRIC CAMBISOL	FREQ = 94	BE,	EUTRIC CAMBISOL	FREQ = 123	BF,	FERRALIC CAMBISOL	FREQ = 0
BG,	GLEYIC CAMBISOL	FREQ = 0	BH,	HUMIC CAMBISOL	FREQ = 7	BK,	CALCIC CAMBISOL	FREQ = 0
BV,	VERTIC CAMBISOL	FREQ = 2	BX,	GELIC CAMBISOL	FREQ = 11	CG,	GLOSSIC CHERNOZEN	FREQ = 0
CH,	HAPLIC CHERNOZEM	FREQ = 30	CK,	CALCIC CHERNOZEM	FREQ = 4	CL,	LUVIC CHERNOZEM	FREQ = 11
DO,	DYSTRIC PODZOLUVISOL	FREQ = 0	DE,	EUTRIC PODZOLUVISOL	FREQ = 8	DG,	GLEYIC PODZOLUVISOL	FREQ = 0
E ,	RENDZINA	FREQ = 16	FA,	ACRIC FERRALSOL	FREQ = 1	FH,	HUMIC FERRALSOL	FREQ = 0
FO,	ORTHIC FERRALSOL	FREQ = 0	FP,	PLINTHIC FERRALSOL	FREQ = 0	FR,	RHODIC FERRALSOL	FREQ = 0
FX,	XANTHIC FERRALSOL	FREQ = 0	GC,	CALCARIC GLEYSOL	FREQ = 1	GD,	DYSTRIC GLEYSOL	FREQ = 140
GE,	EUTRIC GLEYSOL	FREQ = 32	GH,	HUMIC GLEYSOL	FREQ = 1	GM,	MOLLIC GLEYSOL	FREQ = 9
GP,	PLINTHIC GLEYSOL	FREQ = 0	GX,	GELIC GLEYSOL	FREQ = 62	HC,	CALCARIC PHAEOZEM	FREQ = 0
HG,	GLEYIC PHAEOZEM	FREQ = 6	HH,	HAPLIC PHAEOZEM	FREQ = 25	HL,	LUVIC PHAEOZEM	FREQ = 43
I ,	LITHOSOL	FREQ = 315	JC,	CALCARIC FLUVISOL	FREQ = 5	JD,	DYSTRIC FLUVISOL	FREQ = 0
JE,	EUTRIC FLUVISOL	FREQ = 14	JT,	THIONIC FLUVISOL	FREQ = 0	KH,	HAPLIC KASTANOZEM	FREQ = 65
KK,	CALCIC KASTANOZEM	FREQ = 5	KL,	LUVIC KASTANOZEM	FREQ = 140	LA,	ALBIC LUVISOL	FREQ = 149
LC,	CHROMIC LUVISOL	FREQ = 36	LF,	FERRIC LUVISOL	FREQ = 3	LG,	GLEYIC LUVISOL	FREQ = 5
LK,	CALCIC LUVISOL	FREQ = 13	LO,	ORTHIC LUVISOL	FREQ = 60	LP,	PLINTHIC LUVISOL	FREQ = 0
LV,	VERTIC LUVISOL	FREQ = 0	MG,	GLEYIC GREYZEM	FREQ = 0	MO,	ORTHIC GREYZEM	FREQ = 5
NO,	DYSTRIC NITOSOL	FREQ = 2	NE,	EUTRIC NITOSOL	FREQ = 5	NH,	HUMIC NITOSOL	FREQ = 0
OD,	DYSTRIC HISTOSOL	FREQ = 53	OE,	EUTRIC HISTOSOL	FREQ = 7	OX,	GELIC HISTOSOL	FREQ = 95
PF,	FERRIC PODZOL	FREQ = 0	PG,	GLEYIC PODZOL	FREQ = 8	PH,	HUMIC PODZOL	FREQ = 0
PL,	LEPTIC PODZOL	FREQ = 8	PO,	ORTHIC PODZOL	FREQ = 331	PP,	PLACIC PODZOL	FREQ = 0
OA,	ALBIC ARENOSOL	FREQ = 0	QC,	CAMBIC ARENOSOL	FREQ = 0	QF,	FERRALIC ARENOSOL	FREQ = 0
QL,	LUVIC ARENOSOL	FREQ = 0	RC,	CALCARIC REGOSOL	FREQ = 43	RD,	DYSTRIC REGOSOL	FREQ = 3
RE,	EUTRIC REGOSOL	FREQ = 37	RX,	GELIC REGOSOL	FREQ = 472	SG,	GLEYIC SOLONETZ	FREQ = 0
SM,	MOLLIC SOLONETZ	FREQ = 10	SO,	ORTHIC SOLONETZ	FREQ = 2	TH,	HUMIC ANDOSOL	FREQ = 0
TM,	MOLLIC ANDOSOL	FREQ = 1	TO,	OCHRIC ANDOSOL	FREQ = 0	TV,	VITRIC ANDOSOL	FREQ = 38
U ,	RANKER	FREQ = 0	VC,	CHROMIC VERTISOL	FREQ = 1	VP,	PELLIC VERTISOL	FREQ = 21
WD,	DYSTRIC PLANOSOL	FREQ = 0	WE,	EUTRIC PLANOSOL	FREQ = 7	WH,	HUMIC PLANOSOL	FREQ = 0
WM,	MOLLIC PLANOSOL	FREQ = 0	WS,	SOLODIC PLANOSOL	FREQ = 1	WX,	GELIC PLANOSOL	FREQ = 0
XH,	HAPLIC XEROSOL	FREQ = 5	XX,	CALCIC XEROSOL	FREQ = 10	XL,	LUVIC XEROSOL	FREQ = 26
XY,	GYPSIC XEROSOL	FREQ = 0	YH,	HAPLIC YERMOSOL	FREQ = 26	YK,	CALCIC YERMOSOL	FREQ = 10
YL,	LUVIC YERMOSOL	FREQ = 71	YT,	TAKYRIC YERMOSOL	FREQ = 0	YY,	GYPSIC YERMOSOL	FREQ = 0
ZG,	GLEYIC SOLONCHAK	FREQ = 0	ZM,	MOLLIC SOLONCHAK	FREQ = 0	ZO,	ORTHIC SOLONCHAK	FREQ = 0
ZT,	TAKYRIC SOLONCHAK	FREQ = 0	(23,	GLACIER/ICE	FREQ = 293)			

Table 9 (cont'd.)

Table 9.2: Texture Class Cell Frequencies

COARSE	= 986	MEDIUM	= 1449	FINE	= 191	CRS-MED	= 158
CRS-FINE	= 10	MED-FINE	= 67	C-M-F	= 9	ORGANIC	= 38
GLACIER	= 293						

Table 9.3: Slope % Class Cell Frequencies

0-8	= 944	8-30	= 853	>30	= 295	0-30	= 341
0-8, >30	= 29	8->30	= 353	0->30	= 87		

Table 9.4: Phase and Land Unit Cell Frequencies

STONY	= 1049	LITHIC	= 190	PETRIC	= 0	PETFER	= 0	PETCAL	= 7
PETGYP	= 0	FRAGPN	= 30	DURIPN	= 11	SALINE	= 6	PHREAT	= 0
CERRDO	= 0	SODIC	= 0	PRMFRO	= 679	INTPRM	= 664	GLAC	= 293
PONDED	= 115	DUNE	= 2	DEBRIS	= 0	SALTFL	= 1		

Table 9.5: Special Code Cell Frequencies

MISC. SOIL UNIT, PROPERTIES INFERRED	= 1
TEXTURE INTERPRETED	= 106
SLOPE INTERPRETED	= 0
SOILWRLD GLACIER / VEG SOIL	= 2
SOILWRLD SOIL / VEG GLACIER	= 115
NON-FAO SOURCE, VEG GLACIER	= 104
NON-FAO SOURCE, VEG SOIL	= 25

(See text for explanation.)

V. Discussion

The world soil file and the Matthews vegetation and land use file were developed for use with the GISS GCM.[1] Together, they contain data to calibrate ground surface energy and moisture flux governing equations when coupled to a dynamically interactive ground-atmosphere global climate model.

Two other global soil data files for climate models have been organized. The first was developed by Lin, Boch and Alfano (1979) to parameterize water and heat flux equations in a simplified two layer soil profile underlined by a deep ground water layer for use with GLA GCM.[2] The second was developed by Wilson and Henderson-Sellers (1985) (WH-S) as a global archive of soils and land cover for use with the United Kingdom Meteorological Office global climate model. The soil data were obtained from the FAO source, except for eastern Europe. The WH-S article does not state how the data were collected from the source map and aggregated into ½° x ½° grid cells. Their report also does not describe the method used to reduce the soil units to two categories suitable for climate modeling; nor, does it give the properties of each category.

The world soil file is essentially a raw data file rather than a file of climatically classified soils. Groups of soils can be obtained from the file by defining value class intervals for the parameters. To model the role of soils in climate change the properties of subsurface horizons were extrapolated from specific representative site profile descriptions of the same soil unit. These data then may be coupled to a numeric scheme in order to evaluate the sensitivity of soil properties in climate modeling. The world soil file provides the raw data in a form that facilitates user ground surface model experimentation with an atmosphere general circulation model, or with meteorological data as the forcing function. It can, of course, be used for other purposes that require information on the geographical distribution of soils and soil properties.[3]

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1 NASA Goddard Institute for Space Studies, Global Climate Model
2 NASA Goddard Laboratory for Atmospheres, Global Climate Model
3 A tape and documentation of the World Soil File are available on request to NCAR, Data Support Section, P.O. Box 3000, Boulder, CO 80307.

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16. Abstract

This report describes the structure and limitations of a world soil data file of 15,413 records designed for use with a global atmosphere circulation model. Soil data were obtained from the Soil Map of the World, Food and Agricultural Organization, FAO, scale 1:5,000,000. Each record is for a 1° lat. x 1° long. cell; the file describes dominant, associated, and included soil units (defined according to the FAO classification), as well as surface texture, slope, and auxiliary information. The soil file corresponds geographically to a vegetation and land use file. The files have been used concurrently to characterize the land surface in the Goddard Institute for Space Studies Global Climate Model (GISS GCM).

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